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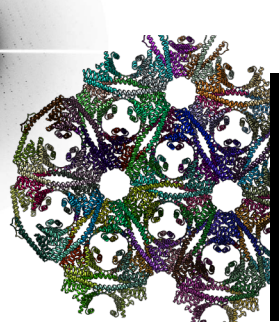
PASTEUR NETWORK

Integrative Bioimaging Hub @ Inst Pasteur Montevideo

a new Research Infrastructure hub in South America



Pasteur Network Annual Meeting

Rome, November 2022

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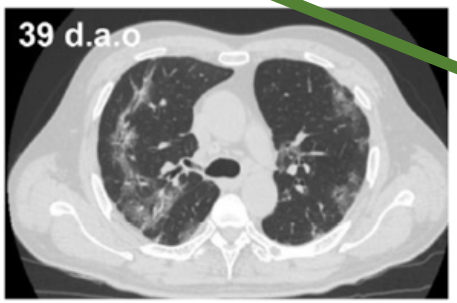
Bioimaging : technologies that enable us to see and measure biological specimens accurately and precisely

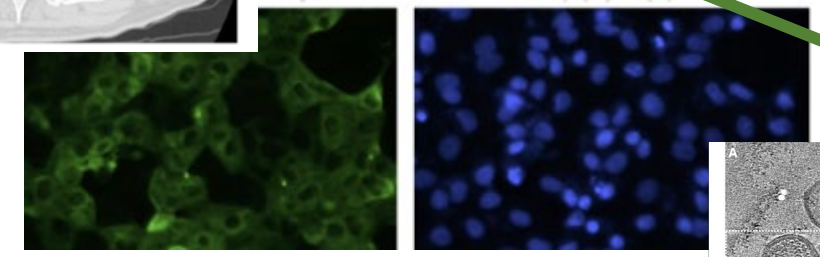
…from whole organisms and their tissues, all the way to subcellular and molecular structures with atomic detail

Examples in many fields of Life Sciences, notoriously along the fight against SARS-CoV2

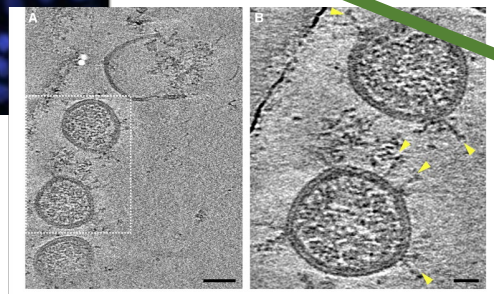
now able to **integrate** a broad spectrum of sizes / spatial resolution



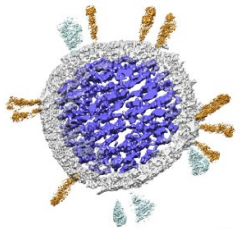
Biomedical imaging

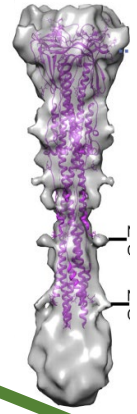


Cellular/subcellular imaging



Subcellular/Molecular imaging





Molecular imaging
Structural Biology

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The Integrative Bioimaging Hub at Institut Pasteur Montevideo

- In **2022 IPMontevideo creates the "Integrative Bioimaging Hub"** (built on top of existing facilities in Structural Biology & Optical Microscopies : PXF & UBA)
- Project conceived/developed in **tight collaboration with the European Research Infrastructure Consortia : Instruct and EuroBioImaging**
- **Strong national and regional partnerships:** networks established (CeBEM & LABI) / connection with large high-end facilities : @CNPEM (Campinas, Brazil) and @Instruct (Madrid, Spain)

A Buschiazzo (group leader)

Protein Crystallography Facility (PXF)

- X-ray diffraction to visualize 3D structures of macromolecules at atomic resolution
- Two crystallization robots
- Liq N_2 generator and cryogenesis systems
- Informatic resources to process data, perform structural analyses and *in silico* protein engineering
- Regular access to synchrotrons (DLS @UK)

Leonel Malacrida (group leader)

Advanced Bioimaging Unit (UBA)

- 2 Laser scanning microscopes
- 2 epifluorescence microscopes
- Two 2-photons mic. being built
- Fiber-optic device for intravital imaging

Machine shop for instrument design/development & processing resources

- 3D printer
- Lathe, miller and welding machines
- 60Tb server + 5 workstations

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Performance of these facilities @IPMontevideo

- ✓ open access to users
- ✓ excellent science as a priority

PXF

- launched in 2007; 10-15 users/year
- User profiles: 50% Inst Pasteur / 25 % Uruguay / 20 % foreign / 5% industry
- More than 150 structures solved, > 60 accessible in the PDB
- > 25 published articles related to PXF services (Science, PNAS, eLife, Nature Plants, Nature Commun, etc)
- 7 advanced, hands-on int'l workshops: >170 students, 70 invited tutors/speakers

UBA

- launched in 2020 ; 90-100 users/year
- 95% from academic teams
- 80% intra-IPM
- ＞100 students / 3 Workshops
- Training and remote access during the pandemics (+25)
- 30-40 internships planned for the next 3 years

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Performance of these facilities @IPMontevideo

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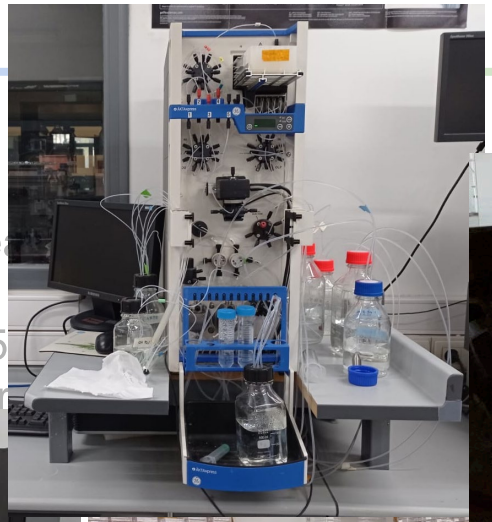
- ce as a priority



UBA

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Integrative Bioimaging Hub

Learn from other initiatives in LAC countries, and replicate the concept of Regional Hubs !! :

- ✓ minimize duplicated efforts (save $$ and boost expertise);
- ✓ be able to address relevant health problems, for the region, and also to respond effectively to crises that may go global !!!

Research Infrastructure Hubs, located at key sites with feasible regional impact, can be

- **a concrete asset within the Pasteur Network**, and also
- catalyzers of stronger interactions within and beyond the Network

ResInfra EU-LAC

instruct ERIC

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CEBEM CENTRO DE BIOLOGIA ESTRUCTURAL DEL MERCOSUR

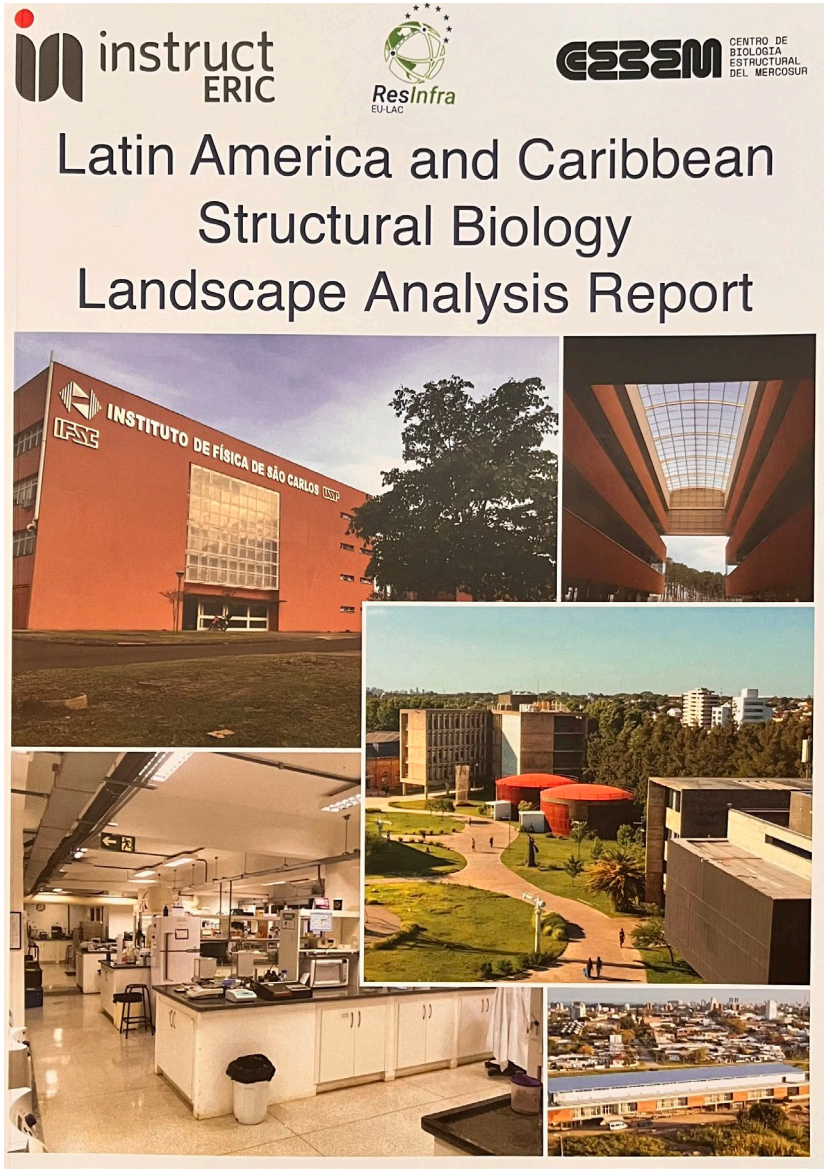
LATIN AMERICA RESEARCH INFRASTRUCTURE LANDSCAPE ANALYSIS IN STRUCTURAL BIOLOGY & PROTEIN SCIENCE

https://zenodo.org/record/7260779#.Y3dOPOzP2h2

Landscape Analysis Report

Report Introduction

- **We explored opinions of structural biologists & protein scientists on how access provision is currently managed in Latin Americ & Caribbean (LAC)**
- make recommendations to improve research infrastructure (RI) provision
- identify opportunities for stronger collaboration between Europe and LAC
- presented/discussed recently at the Int'l Conference on Research Infrastructure ICRI2022 (Brno, Czech Rep)



Landscape Analysis Report

Working Group

- Alejandro Buschiazzo – Inst Pasteur Montevideo, Uruguay
- María-Natalia Lisa – IBR, Argentina
- Chuck Shaker Farah – Univ Sao Paulo, Brazil
- Ana Zeri – LNLS/CNPEM, Brazil
- Jose Maria Carazo – CNB-CSIC, Spain
- Alberto Podjarny – IGBMC, France
- John Dolan – Instruct-ERIC, UK
- Pauline Audergon – Instruct-ERIC, UK
- Natalie Haley – Instruct-ERIC, UK
- Claudia Alen Amaro – Instruct-ERIC, UK
- Richard Garratt – University Sao Paulo, Brazil

CNPEM

Institut Pasteur de Montevideo

CNB CENTRO NACIONAL DE BIOTECNOLOGIA

USP

igbmc institut de génétique et de biologie moléculaire et cellulaire

CONICET

UNIVERSIDAD NACIONAL DE ROSARIO

I I D E F A R

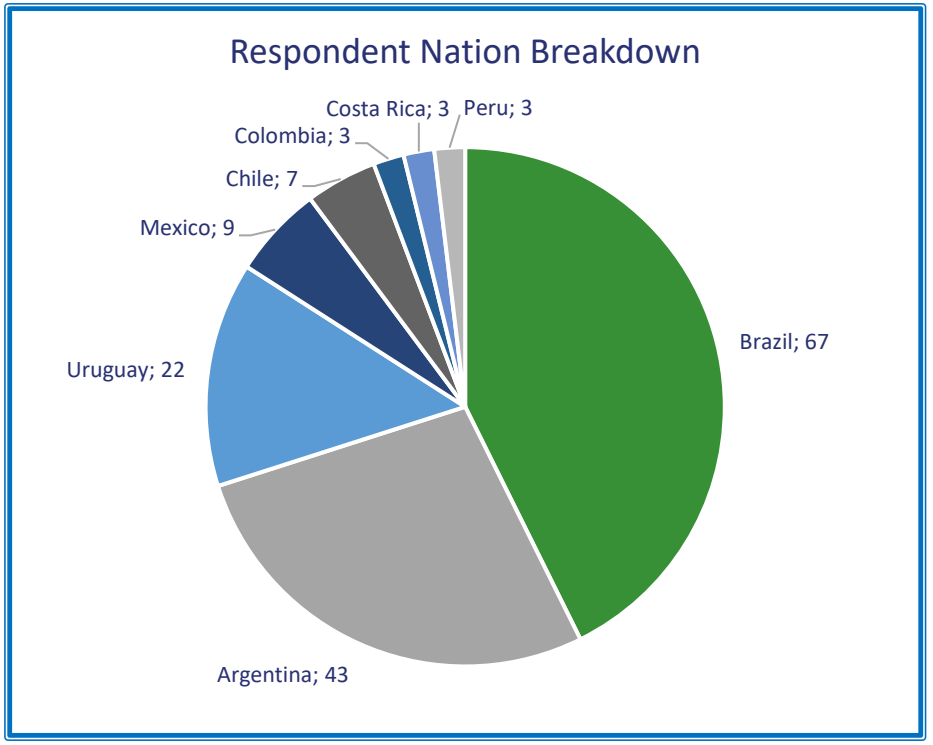
instruct ERIC

CEBEM CENTRO DE BIOLOGIA ESTRUCTURAL DEL MERCOSUR

Landscape Analysis Report

Survey Analysis

- **281 structural biologist & protein scientists in Latin America were contacted**
- **29 one-on-one interviews with key actors**
- Just starting! we will continue to broaden this first base of interlocutors



https://zenodo.org/record/7260779#.Y3dOPOzP2h2

Landscape Analysis Report

Conclusions and Recommendations

- **access to Research Infrastructures is a key component** for competitive research, and to enable appropriate and timely responses to health challenges
- **regional hubs in LAC are highly recommended** to use high-end RI more efficiently: democratization of state-of-the-art technology
- a need to establish a **regional roadmap** to develop Structural Biology and Protein Science in LAC : to boost both fundamental science and applications
- **connect leaders of the scientific community with science policy makers**
- improve the **training strategies/actions** for facility staff - cooperation with EU will enable establishing best practices in common

https://zenodo.org/record/7260779#.Y3dOPOzP2h2

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Summary and Future Directions

- **A new Integrative Bioimaging Hub has been created at the Inst Pasteur Montevideo**, as an open access research infrastructure
- Built in tight collaboration with Instruct-ERIC and Euro-BioImaging, and regional RIs;
- Initial funds obtained by UBA & PXF, synergic for the nascent regional IBHub (Chan Zuckerberg Initiative, CYTED, EU-LAC Working Group 2023-2025);
- Explicit endorsement from the Uruguayan government (although facing limited funds for large equipment: **important bottleneck towards a goal of securing minimal set of RI capacities in every region of the world, enable competitiveness & responsiveness globally**);
- IPMontevideo allocated funds to launch the Hub's first steps in cryo-EM (sample preparation & data processing). Beginning of cryoEM operations in 2023, in tight cooperation with high-end infrastructure LNNano (Brazil) and CNB-CSIC (Madrid Instruct node).
- Several other grant applications underway / partners identified : Chan Zuckerberg Initiative (instrumentation), Horizon Europe (advanced training & cooperation), etc
- Looking forward to **work within the Pasteur Network : exploit this initiative, and connect it among the Network's nodes and beyond** at the Int'l level

our Team in Montevideo

PXF staff

https://pasteur.uy/en/units/protein-crystallography

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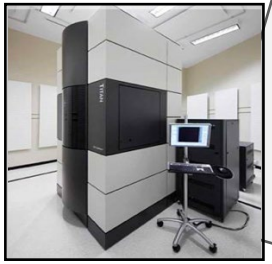
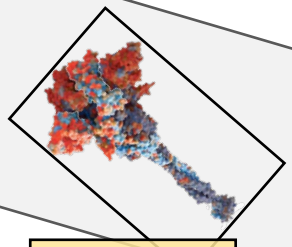
cryo-electron microscopy

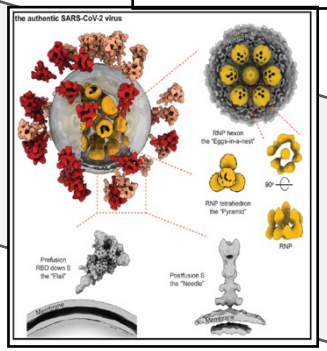


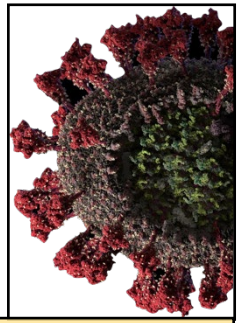
allowed to image the *spike protein* from SARS-CoV-2...



Molecule's size :
~20 nm long

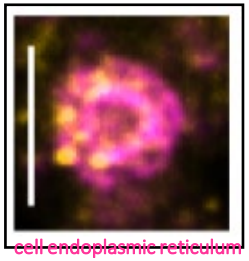
...and thus design appropriate antigens to produce efficacious vaccines





Virus diameter :
~90 nm

Understanding the mechanisms of infection and reproduction used by SARS-CoV-2 in host cells



~~cell endoplasmic reticulum~~
viral nucleocapsid

Image size :
~1 µm

Spatio-temporal localization of SARS-CoV-2 proteins within host cells

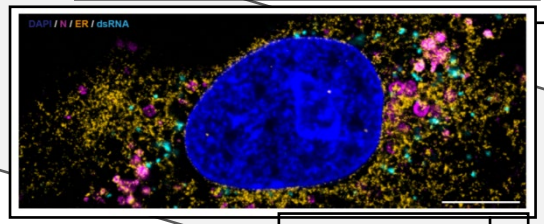
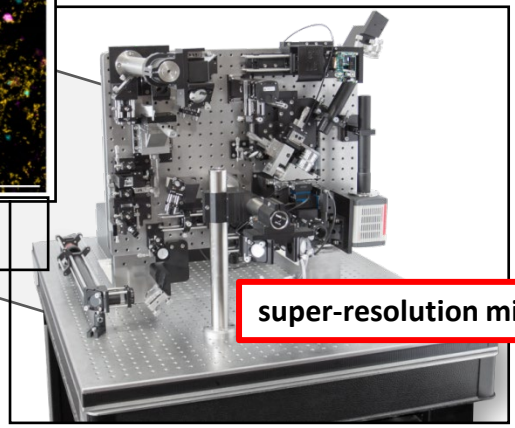


Image size :
50 µm



super-resolution microscopy

Thank you!